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Oral mucosal lesions during orthodontic treatment

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Background. Oral mucosal lesions can result from irritation caused by orthodontic appliances or malocclusion, but their frequency is not known.

Aim. To examine the frequency of oral mucosal lesions in wearers of orthodontic appliances in comparison to children with malocclusion.

Design. This study comprised 111 subjects: 60 wearers of orthodontic appliances and 51 controls (aged between 6 and 18 years). Type and severity of mucosal lesions, their topography, gingival inflammation, and oral hygiene status were determined by using clinical indices.

Results. Mucosal lesions were more present in wearers of orthodontic appliances than in children with malocclusion. Gingival inflammation, erosion, ulceration, and contusion were the most common findings in orthodontic patients. The severity of gingival inflammation was in correlation with oral hygiene status; the poorer oral hygiene, the more severe gingival inflammation was. Better oral hygiene status was found in children during orthodontic treatment than in children with malocclusion.

Conclusions. Orthodontic treatment carries a higher risk of mucosal lesions and implies greater awareness of better oral hygiene as shown by the results of this study. Oral hygiene instructions and early treatment of oral lesions are important considerations in better patient's motivation, treatment planning, and successful outcome.

Introduction

Local tissue damage is one of the intraoral risks during orthodontic treatment[1]. Ulcerations, pain, and discomfort are frequent side effects, which result from irritation caused mainly by fixed orthodontic appliances[2,3]. Although painful and unpleasant, lesions heal quickly because of the fast metabolism of oral mucosa in young and healthy orthodontic patients[4].

However, oral lesions may result from interactions of dental cast alloys and oral tissues as well. These interactions result from bacterial adherence, toxic, subtoxic, and allergy effects caused by metal ions and allergy[5]. Direct interactions between orthodontic appliances and periodontal tissues may present a considerable challenge[1].

Besides, during orthodontic treatment with fixed appliances, challenging oral hygiene situation because of trapped food and oral debris around brackets could contribute to the development of gingival inflammation[6].

Recent literature reports quite a small number of studies dealing with frequency and type of oral mucosal lesions during orthodontic treatment. Conversely, clinical experience shows that lesions of oral mucosa in wearers of orthodontic appliances are pretty common findings in everyday practice, thus affecting the motivation and duration of orthodontic therapy. Therefore, the aim of this study was to examine the frequency and type of mucosal lesions in the wearers of orthodontic appliances and to compare these results with a control group of patients who were diagnosed malocclusion, and were not actively involved in orthodontic treatment.

Material and methods

Study groups

The study comprised 111 patients, of which 60 were wearers of orthodontic appliances

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(33 boys and 27 girls) and 51 (27 boys and 24 girls) were controls with malocclusion. The patients' age ranged from 6 to 18 years (mean age 13.25 in the experimental group and 11.86 in the control).

All children from the experimental group were already in the orthodontic treatment and were referred by the orthodontist for the purpose of this study. To examine the association between the types of orthodontic appliances and oral mucosal lesions, subjects were divided into three groups: wearers of removable bimaxillary orthodontic appliances (18 patients), wearers of removable monomaxillary appliances (24 patients), and wearers of fixed orthodontic appliances (18 patients).

Children from the control group were referred by their paediatric dentist because of detected malocclusions that had not been orthodontically treated.

In all patients, medical history was obtained and oral examination was performed during which oral lesions were detected and recorded including gingival and mucosal inflammation as well as oral hygiene status. Medical history included data related to systemic diseases and verified allergy to known allergens and medications. Exclusion criteria referred to all the patients with systemic or chronic diseases, allergy, and those patients who were taking medications for any of the above mentioned reasons.

The study was approved by the Ethical Committee, School of Dental Medicine, University of Zagreb. Prior to signing a written consent, each participant was thoroughly explained the purpose of the study. As all the subjects were under 18 years of age, prior to commencing the study, a written consent was required by their parents[7].

Clinical examination

Oral medicine specialists performed oral examination in all patients and detected oral mucosal lesions in a standard manner using procedure based on internationally accepted criteria[8]. Lesions were recorded according to their clinical appearance including surface morphology, size, colour consistency, and location, and were grouped in five categories: inflammation, contusion, desquamation, erosion, and ulceration. Such classification of lesions was applied to unify criteria for assessing lesions in both groups of patients. Only mucosal lesions present at the time of examination were recorded.

The size of lesion was graded from 1 to 3: 1 indicating lesion up to 1 cm in size, 2 indicating lesion from 1 to 3 cm in size, and 3 indicating lesion larger than 3 cm in size.

The severity of oral mucosa inflammation was determined and graded based on the following clinical criteria[9]:

- Degree 1 indicates barely visible localized inflammatory reaction presented by a lighter red colour and <1 cm in diameter.
- Degree 2 indicates medium intensity of inflammatory reaction, with moderately red colour of oral mucosa varying from degree 1 to 3; no more than 2 cm in diameter.
- Degree 3 indicates severe inflammatory reaction presented by a darker red colour, spreading extensively more than 2 cm in diameter.

The oral hygiene status and gingival inflammation were recorded according to verified clinical indices[10,11].

Gingival inflammation was assessed by Löe and Silness' gingival index[10]:

- 0 = normal gingival
- 1 = mild inflammation, slight change in colour, slight oedema, no bleeding on palpation
- 2 = moderate inflammation, redness, oedema, glazing, bleeding on palpation
- 3 = severe inflammation, marked redness and oedema, ulceration, tendency to spontaneous bleeding

The oral hygiene status was determined according to Silness and Löe's plaque index[11]:

- 0 = without plaque deposits
- 1 = plaque is revealed by periodontal explorer after gingival margin probing
- 2 = plaque is visible and involves a cervical third of the tooth
- 3 = huge plaque deposits involving two-thirds of the tooth

Modification from the applied Silness and Löe's plaque index was made only in those children who did not have first bicuspids and

lateral incisors at the time of conducting the survey. Instead, simplified oral hygiene index, implying the same criteria, was used.

The topography of lesion was recorded according to WHO scheme (Fig. 1), as proposed by Roed-Petersen and Roenstrup[8].

Statistical analysis

All data were analysed by using χ^2-test. Due to low frequency of observed variables, Fisher's exact test was used in a certain number of cases. *P*-values <0.05 were considered as statistically significant. In some cases, the results were interpreted only in terms of quality and without any assessment of statistical significance.

Results

The frequency and distribution of oral mucosal lesions between groups is presented in Fig. 2. One or more mucosal lesions were found in 38 wearers of orthodontic appliances (63%) and in 24 patients with malocclusion (47%).

The most frequent lesions in the experimental group were erosions (7%), ulcerations (7%), contusions (7%), and desquamations (5%) as a result of trauma caused by orthodontic appliance. Ulceration, erosion, and desquamation were mainly related to wearing fixed orthodontic appliances, whereas erosions and inflammation detected underneath the appliance were more related to the use of removable orthodontic appliances. Brackets from fixed orthodontic appliance mostly caused erosions and desquamations, whereas archwire caused ulcerations (Fig. 3). In one patient, mucocele developed due to constant, slight pressure and friction of archwire to the oral mucosa of the left cheek. In patients with removable orthodontic appliances, inflammation under the palatal plate was the most common finding, whereas less-frequent erosions were present due to friction against palatal screw, or desquamation found due to irritation caused by interdental clasps (Figs 4 and 5).

All lesions were accompanied by inflammation, whereas inflammation as a solitary

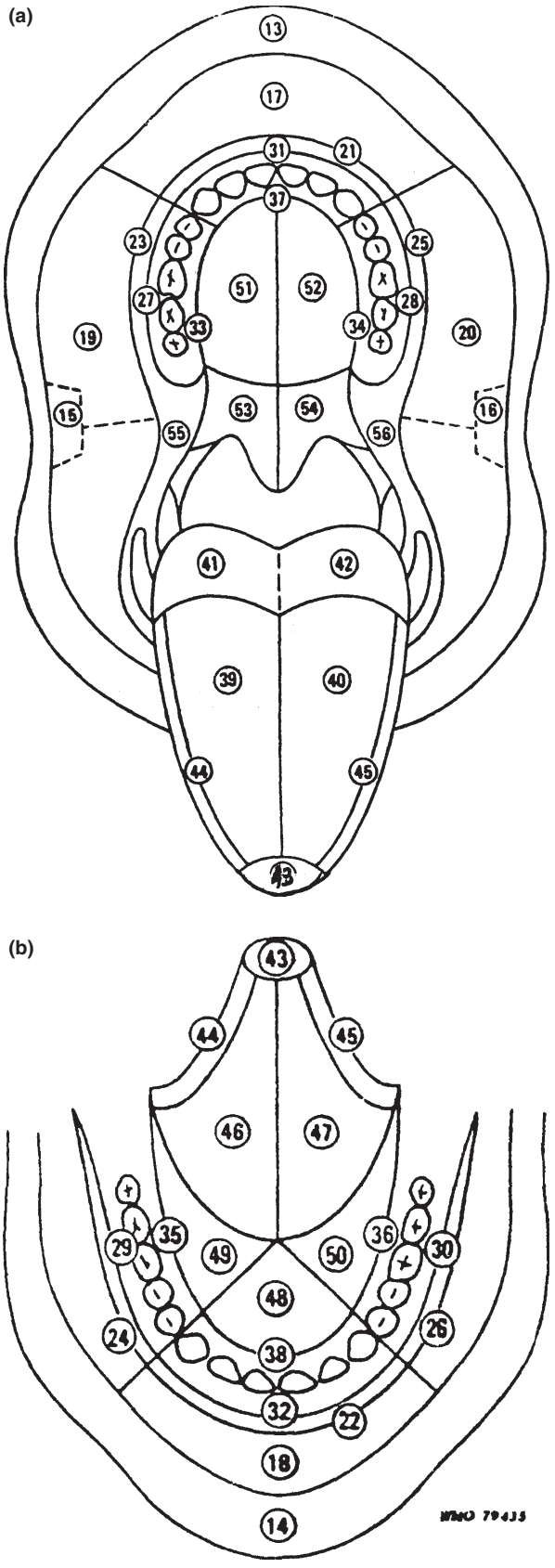

Fig. 1. (a and b) Topography of oral mucosa by WHO modified after Roed-Petersen and Renstrup.

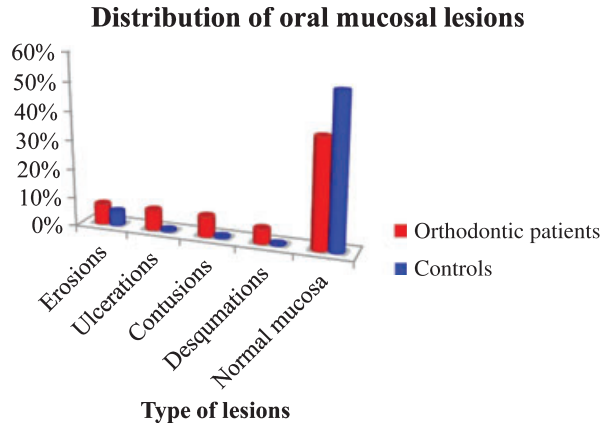

Fig. 2. Distribution of all mucosal lesions found in experimental and control group.

Fig. 3. Aphthous ulcers on the lower lip mucosa.

Fig. 4. Erosion on the tongue mucosa due to friction against palatal screw.

Fig. 5. Desquamation of the buccal mucosa as a result of permanent mucosal irritation caused by interdental clasps.

Table 1. Intensity of oral mucosal inflammation between groups.

Inflammation intensity	Experimental group (number of patients)	Control group (number of patients)
1 (Weak)	12	15
2 (Medium)	23	8
3 (Severe)	3	1
Mean intensity	1.76	1.41

diagnosed occurrence was only present under removable orthodontic appliance. Inflammation intensity in both groups of patients was mostly weak or medium (Table 1.).

The localization of mucosal lesions corresponded to the spot where the orthodontic appliance caused trauma. According to WHO topography, injuries caused by fixed orthodontic appliances were on the buccal and vestibular mucosa as well as on the lower lip (regio 14, 17, 18, 19, 20, 24, 26, 29, 30), whereas, in the wearers of removable orthodontic appliances, lesions were found on the hard palate, tongue, and vestibular mucosa of the lower jaw (regio 24, 26, 39, 40, 51, 52).

In children with malocclusion, lesions of oral mucosa occurred less frequently; the most common were buccal and vestibular erosions (5.1%), mainly resulted from biting, or caused by aphthous stomatitis or viral infection.

Gingival inflammation was the most frequent finding in both groups of patients. In orthodontic patients, gingival inflammation was present in 36.3% and 40.7% of control patients. In the wearers of fixed orthodontic appliances, gingival inflammation was most frequently found in marginal gingiva of the upper and lower jaws. In patients with malocclusion, inflammation was equally frequent

in vestibular marginal gingiva of the upper and lower jaws, as well as on the palatal sides of marginal gingiva. A higher intensity of gingival inflammation was present in the subjects with fixed orthodontic appliances compared with wearers of removable orthodontic appliances.

Although no statistically significant differences were observed regarding oral hygiene status among the wearers of orthodontic appliance, poorer oral hygiene was found in the wearers of fixed orthodontic appliances. Subjects from the experimental group had a better oral hygiene in comparison to control group, yet with no statistically significant differences ($P > 0.05$). The frequency and intensity of gingival inflammation was in correlation to the oral hygiene degree: the poorer the oral hygiene, the more frequent and intensive gingival inflammation was ($P < 0.05$).

Gingival inflammation was evaluated depending on a patient's gender and age, as well as the type of dentition. The inflammation was more frequent and of higher intensity in boys ($P > 0.05$), in younger patients ($P > 0.05$), and in subjects with mixed dentition ($P > 0.05$), yet without any significant differences either.

Discussion

In this study, mucosal lesions were more frequently present in the wearers of orthodontic appliances than in controls.

In the wearers of orthodontic appliances, most mucosal lesions were related to trauma caused by such appliances. Erosion and ulceration were the most frequent mucosal lesions in wearers of fixed orthodontic appliance. Data from Kvam *et al.*[2] showed that among wearers of fixed orthodontic appliances, 75.8% of patients had small wounds, whereas 2.5% had bad ulcerations, although clinical appearance of small wounds was not described.

The localization of oral mucosal lesions caused by fixed orthodontic appliances, according to WHO scheme, was on buccal and vestibular mucosa, where the archwire and brackets caused erosions and desquamations, and on the lower lip where brackets and wire caused ulcerations. According to Travess *et al.*[1], ulceration or hyperplasia, in the fixed orthodontic patients, resulted from irritation caused by the arch wire and bonds, or wire resting against the lips. In the wearers of removable orthodontic appliances, mucosal inflammation was the most frequent finding. Inflammation of the palatal mucosa under palatal plate was related to yeast infection, whereas erosions mostly occurred as a result of irritation caused by interdental clasps or unsuitable habit caused by tongue pushing the palatal screw and consequently resulting in tongue injury.

Damaged epithelium of oral lesions in which nerve endings are exposed provokes painful sensation. Data from the literature mostly focuses on pain as a consequence of application of forces to induce tooth movement[3,12–14] rather than pain resulting from oral mucosal lesions[15]. According to Bergius *et al.*[16], motivation is the willingness to endure pain during orthodontic treatment. Therefore, preventing oral lesions means preventing pain and increasing patient's motivation.

Gingival inflammation was more frequently observed in 77% of subjects from both groups. The severity and frequency of gingival inflammation was higher in patients with poorer oral hygiene status. In the experimental group, the intensity of gingival inflammation was higher in wearers of fixed orthodontic appliances compared with wearers of removable orthodontic appliances. This complies with other studies, which proved that almost all patients' wearers of fixed orthodontic appliances experienced gingival inflammation[1,2,17]. The localization of gingival inflammation in these patients was present in marginal gingiva of the upper and lower jaws. According to Rafe *et al.*[6], this site is where plaque is usually accumulated in wearer of fixed orthodontic appliances. Gingival inflammation was more present in boys and younger patients as a result of poor oral hygiene. Conversely, data from the literature suggested that younger patients cooperate better[18].

In the control group, gingival inflammation was more present in subjects with poorer oral hygiene and those having malocclusions such as maxillary and mandibulary crowding,

which interfered with physiological cleaning due to saliva flow. This finding corresponds with data from the literature that showed lower frequency of gingival bleeding in wearers of orthodontic appliances compared with subjects who were not in orthodontic treatment[19,20].

Better oral hygiene was observed in wearers of orthodontic appliances who previously acquired oral hygiene instructions from their orthodontist, before even such an orthodontic treatment commenced. Ay *et al.*[21] showed that the oral hygiene motivation method performed by patients under the supervision of their clinician allowed more successful elimination of plaque as well as inflammatory symptoms in patients with fixed orthodontic appliances. In the wearers of orthodontic appliances, the use of adjuncts such as electric toothbrushes, interproximal brushes, chlorhexidine mouthwashes, fluoride mouthwashes, and regular professional cleaning should be introduced in an everyday hygiene regimen[1,22]. However, in performing oral hygiene measures, the patient's motivation is the key to assessing satisfactory oral hygiene status. Patients who were unable to maintain a healthy oral environment in the absence of orthodontic appliance had even worse oral hygiene when fixed orthodontic appliances were placed on the teeth[1].

Among the studies we assessed, very few were dealing with the frequency and type of oral mucosal lesions in wearers of orthodontic appliances. Therefore, this research was undertaken to determine the frequency and type of these lesions in both wearers of orthodontic appliances and in children with malocclusion. More mucosal lesions were present in patients with orthodontic appliances as a result of trauma. Clinical appearance of mucosal lesions and their localization were associated with the type of orthodontic appliance. Being able to prevent and treat these lesions would consequently reduce pain and increase patients' motivation. Following good oral hygiene instructions acquired prior to starting the treatment is vitally important in order to subsequently avoid gingival inflammation and hard tissue damage.

What this paper adds

- This study explores the frequency and type of oral mucosal lesions in both wearers of orthodontic appliances and children with malocclusion
- More lesions are found in wearers of orthodontic appliances as a result of trauma
- The intensity of gingival inflammation was related to oral hygiene status. The poorer the oral hygiene, the more intensive the inflammation was.

Why this research is important for paediatric dentists

- Oral mucosal lesions are more frequently found in orthodontic patients than in patients with malocclusion. Therefore, to be able to identify the type of lesion as well as its ethological background plays an important role in early diagnosis and treatment of these lesions in order to avoid pain and accelerate healing, which leads to improving oral function and the quality of life in younger patients during orthodontic treatment.
- Maintaining satisfactory oral hygiene habits is crucial for further prevention of gingival inflammation and hard tissue damage in both children with malocclusion and children during orthodontic treatment.

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